

分布式会话跟踪系统架构设计与实践

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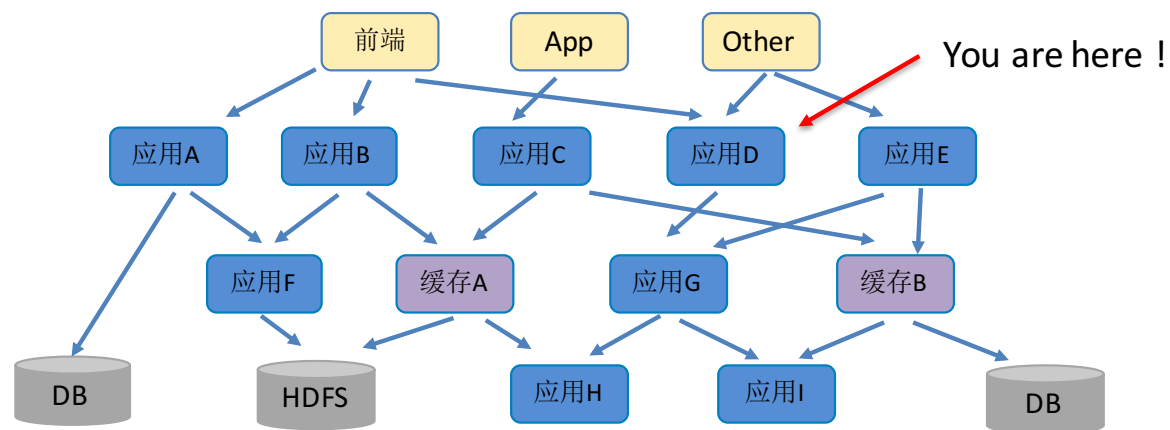
What How Why

- mtrace 项目介绍
- mtrace 使用场景
- mtrace 设计实现

Mtrace

背景

- 日益复杂的分布式系统
- 梳理服务之间的调用关系
- 不同中间件之间相互调用
- 业务感知不到上下游关系



Example

- 警察抓小偷
 - 13:45 小偷去便利店买些道具
 - 14:00 小偷入室行窃并逃逸
 - 18:00 小偷买了开往xxx地的车票
 - 20:00 小偷在xxx酒店入住
 - 20:10 小偷给家里打了个电话
 - 23:00 小偷被抓获



破案关键-身份证

- 你买了些什么商品，银行流水
- 你去过哪里，买了到哪的车票
- 你的电话号是多少
- 你什么时间在哪住过酒店



Example

通过**身份证号**将犯罪轨迹串联起来

- 123456 在xx超市买了xxx
- 123456 在xx路上行窃后逃逸
- 123456 买了去xxx地的车票
- 123456 住入了xx酒店

是否也可以通过一个**id**将请求串联起来

- ? 服务A调用了服务B
- ? 服务B调用了服务C, 出现结果异常
- ? 服务C调用了服务D
- ? 服务D调用了服务E

项目介绍

- Mtrace 分布式会话跟踪系统
- 调用链
 - 通过全局id将分布在各个服务上的一次请求串联起来,还原调用关系,追踪问题,分析数据
- 各维度业务指标统计
 - 统计数据, 业务服务QPS, TP数据, 可用性



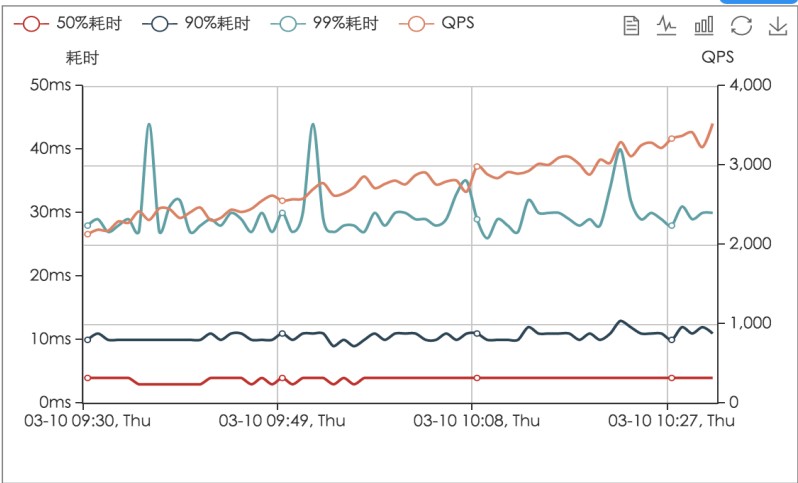
站在巨人的肩膀上

- Dapper, Google
 - Google 2010 年发布dapper论文
- Zipkin, Twitter
 - Zipkin dapper的开源实现
- EagleEye, Taobao
 - 阿里丰富调用链所做的事情



性能分析-统计

接口 #	调用总量 #	成功数/百分比 #	异常数/百分比 #	过期数/百分比 #	QPS(次/秒)占比, 同比 #	TP50耗时(毫秒)占比, 同比 #	TP90耗时(毫秒)占比, 同比 #	TP95耗时(毫秒)占比, 同比 #	TP99耗时(毫秒)占比, 同比 #	最大耗时(毫秒) #	调用链 #
all	159640542	159640542, 100.0000%	0, 0.0000%	0, 0.0000%	1723.321, -34%, -32%	4	28.3%, 7%	58	312	24020	🔗
CheckAliveController.update	71515116	71515116, 100.0000%	0, 0.0000%	0, 0.0000%	1672.438, 0%, -1%	0	1, 0%, 0%	1	1	23	🔗
IndexApi.reportIndexLocation	23288033	23288033, 100.0000%	0, 0.0000%	0, 0.0000%	544.605, 94%, -52%	10	13.8%, 8%	14	25	509	🔗
ReportApi.reportClick	14004181	14004181, 100.0000%	0, 0.0000%	0, 0.0000%	327.495, -44%, -33%	4	7, 0%, 3%				
PolingApi.getPolingData	10632104	10632104, 100.0000%	0, 0.0000%	0, 0.0000%	248.84, -50%, -53%	15	20, 3%, 1%				
WaybillApi.waitingHomeBrowse	8296222	8296222, 100.0000%	0, 0.0000%	0, 0.0000%	194.014, -46%, -48%	21	308, 138				
WaybillApi.waiting425	4460121	4460121, 100.0000%	0, 0.0000%	0, 0.0000%	104.301, -45%, -50%	13	41, 20%				
WaybillApi.kioskHomeBrowse	3962681	3962681, 100.0000%	0, 0.0000%	0, 0.0000%	92.61, -42%, -39%	61	312, 338				
WaybillApi.waitingLike	3756002	3756002, 100.0000%	0, 0.0000%	0, 0.0000%	78.483, -40%, -42%	31	58, 28%				
WaybillApi.waitingLikeHomeBrowse	2983627	2983627, 100.0000%	0, 0.0000%	0, 0.0000%	68.751, -38%, -39%	28	312, 790				
WaybillApi.kioskHomeBrowse	2489307	2489307, 100.0000%	0, 0.0000%	0, 0.0000%	58.215, -47%, -40%	42	311, 380				
WaybillApi.readReview	1811967	1811967, 100.0000%	0, 0.0000%	0, 0.0000%	42.408, -57%, -49%	5	6, 0%, 0%				
WaybillApi.detailHomeBrowse	1668171	1668171, 100.0000%	0, 0.0000%	0, 0.0000%	39.012, -49%, -40%	31	311, 840				
ClientApi.getAppConfig	967596	967596, 100.0000%	0, 0.0000%	0, 0.0000%	22.638, -34%, -32%	17	23, 4%, 1%				
DeviceConfigApi.deviceConfig	759973	759973, 100.0000%	0, 0.0000%	0, 0.0000%	17.773, -10%, -12%	1	1, 0%, 0%				
CheckUpdatesApi.checkUpdate	705249	705249, 100.0000%	0, 0.0000%	0, 0.0000%	16.491, -30%, -34%	10	12, 0%, 1%				
CheckAliveController.root	664532	664532, 100.0000%	0, 0.0000%	0, 0.0000%	15.541, -43%, -44%	0	1, 0%, 0%				
ReportApi.reportPushTaken	567725	567725, 100.0000%	0, 0.0000%	0, 0.0000%	13.272, -17%, -4%	9	12, 0%, 1%				
WaybillApi.countWaybill	555817	555817, 100.0000%	0, 0.0000%	0, 0.0000%	12.999, -66%, -63%	9	310, 308				
WaybillApi.kioskIndexPsi	541348	541348, 100.0000%	0, 0.0000%	0, 0.0000%	12.66, -34%, -30%	14	312, 213				
WaybillApi.grainWaybillHomeBrowse	516723	516723, 100.0000%	0, 0.0000%	0, 0.0000%	12.084, -43%, -41%	72	311, 288				
StatisticsApi.getStatisticsProfile	507403	507403, 100.0000%	0, 0.0000%	0, 0.0000%	11.866, -16%, -23%	8	57, 72%				
WaybillApi.deliveryWaybill	470689	470689, 100.0000%	0, 0.0000%	0, 0.0000%	11.002, -47%, -44%	308	311, 747%, 1740%	315	334	604	🔗
StatisticsApi.getChargePayStatistics	456289	456289, 100.0000%	0, 0.0000%	0, 0.0000%	10.671, -69%, -68%	8	10, 0%, 0%	11	16	1013	🔗
MessageApi.getUnreadCount	438017	438017, 100.0000%	0, 0.0000%	0, 0.0000%	10.244, -9%, -8%	6	7, 0%, 0%	8	14	210	🔗
WaybillApi.fetchWaybill	404048	404048, 100.0000%	0, 0.0000%	0, 0.0000%	9.445, -53%, -51%	16	311, 1627%, 1427%	313	319	608	🔗
IndexApi.getIndexInfo	394119	394119, 100.0000%	0, 0.0000%	0, 0.0000%	9.236, -7%, -4%	12	65, 1%, 4%	74	113	410	🔗



调用链路

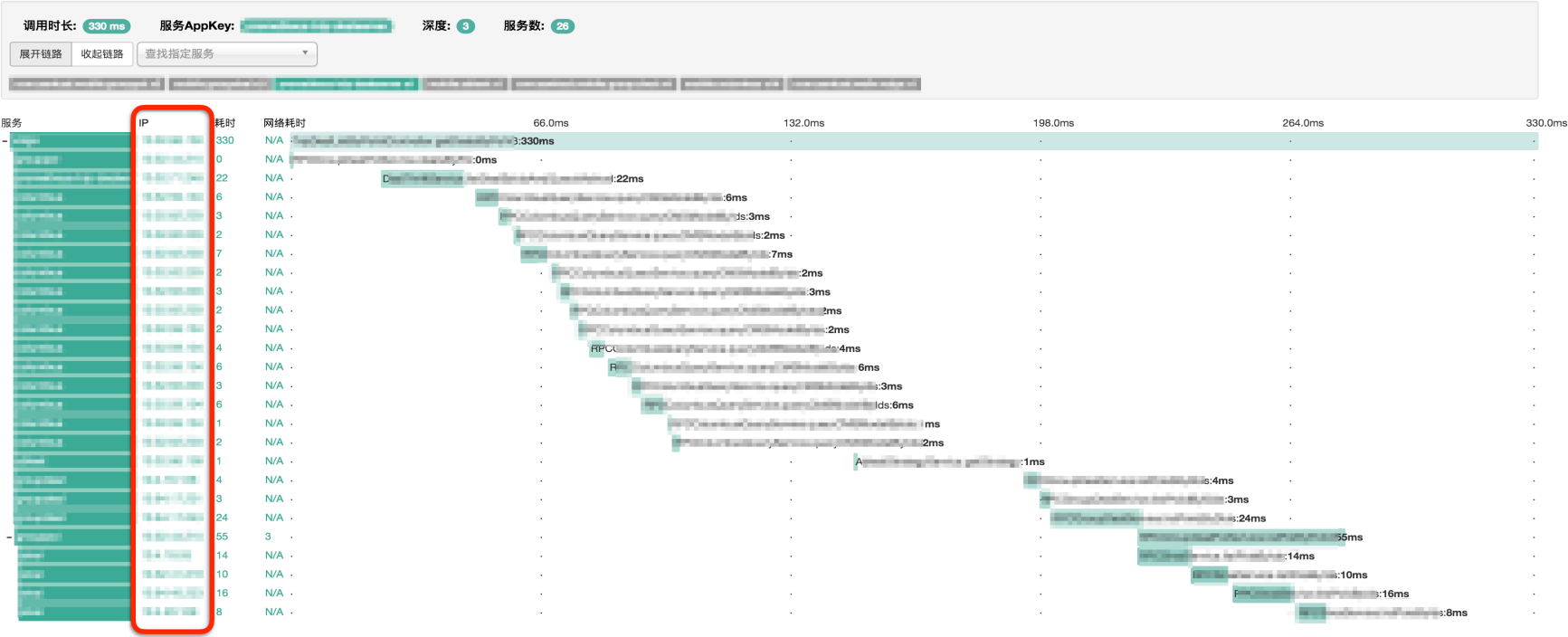


调用链面板，展示了该次调用所经过的各个服务的概况信息

服务间层级关系，服务名，具体ip，耗时等信息

调用链路图，各个服务的调用情况

请求路由



通过实际的调用ip查询跨机房调用等情况

链路分析



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1. Conflicting priorities

2. Conflicting with 1st value

3. Conflicting with 2nd

4. Conflicting with 3rd

5. Conflicting with 4th

6. Conflicting with 5th

7. Conflicting with 6th

8. Conflicting with 7th

9. Conflicting with 8th

10. Conflicting with 9th

11. Conflicting with 10th

12. Conflicting with 11th

13. Conflicting with 12th

14. Conflicting with 13th

15. Conflicting with 14th

16. Conflicting with 15th

17. Conflicting with 16th

18. Conflicting with 17th

19. Conflicting with 18th

20. Conflicting with 19th



链路分析

- 以前
 - 业务查log，需要登录N台机器mapping请求，定位问题
- 现在
 - 业务log 会打印当前请求的traceId，通过调用链定位超时等异常问题
 - 关联整个链路上不同服务间的异常栈

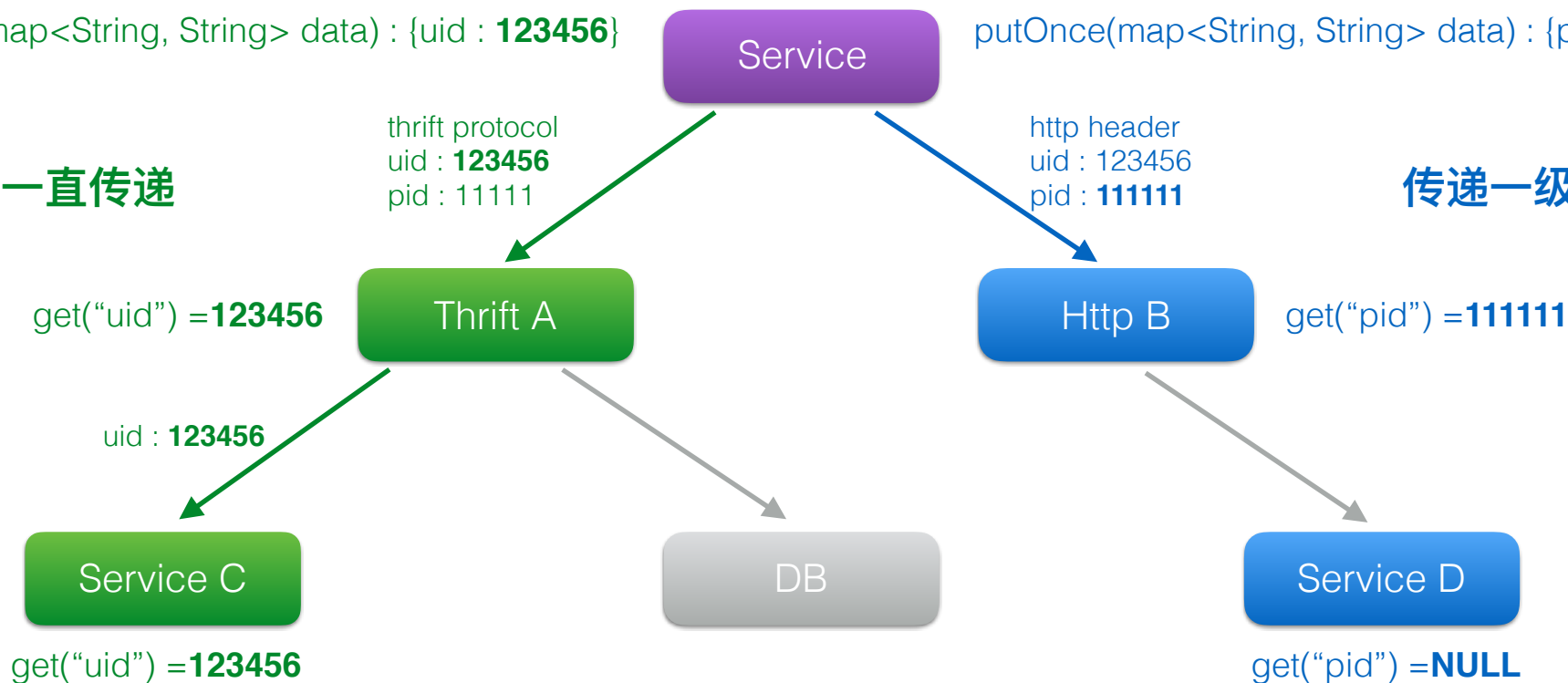
透明传输数据

put(map<String, String> data) : {uid : **123456**}

putOnce(map<String, String> data) : {pid : **111111**}

一直传递

传递一级

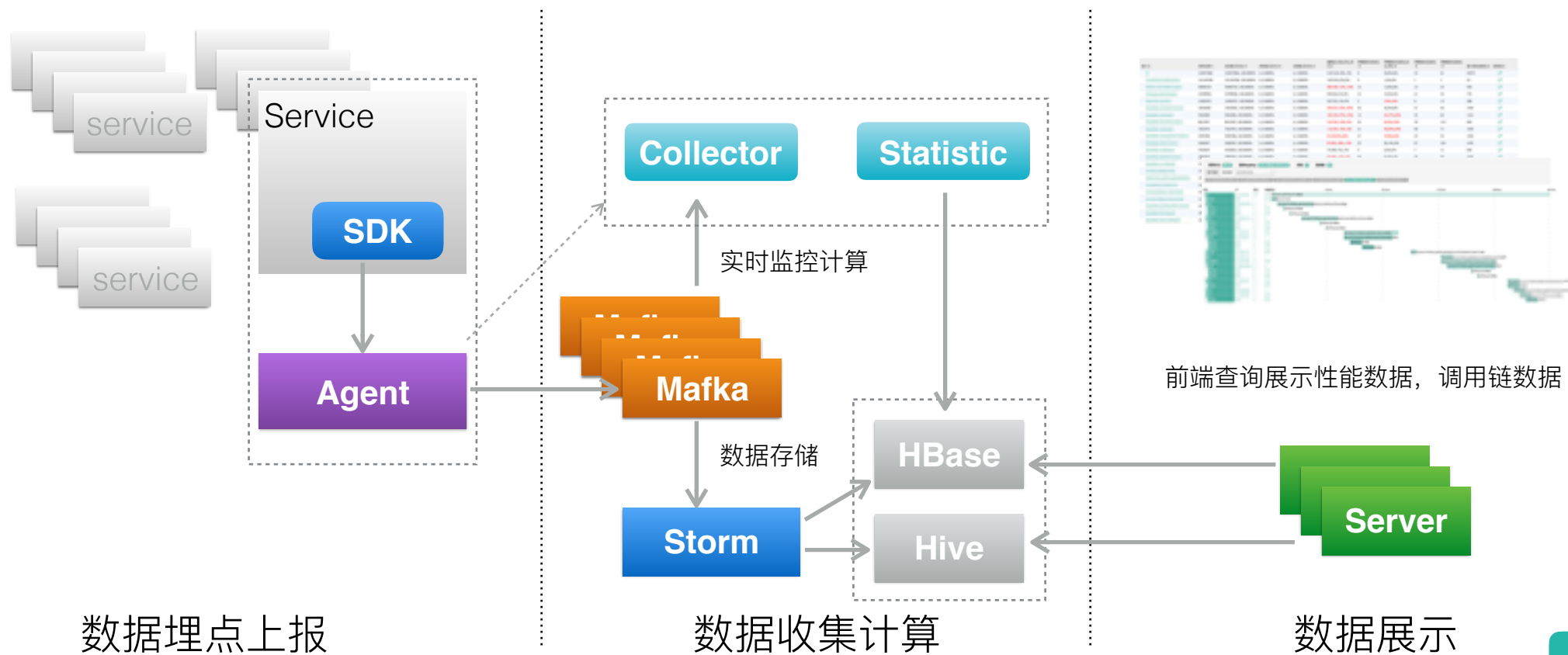


透明传输数据

- Mtrace 自身数据
 - traceId, spanId, sample, debug
- 业务自定义数据
 - KV 结构
 - 路由策略控制：通过参数控制后端处理的逻辑选择
 - 调试指令：通过调试指令进行一些业务log的追踪
 - 临时数据：临时传递数据



系统架构



数据埋点

- SDK

- 埋点，生成调用上下文
- 同步调用上下文存放在ThreadLocal, 异步调用通过显式调用支持
- 网络中传输关键埋点数据，用于数据传递，支持thrift, http协议

- Agent

- 透传数据，用作数据转发
- 做流量控制



数据埋点

- 埋点中间件
 - RPC 服务 : mtthrift
 - Http 服务 : mtrace-http
 - Mysql : mtrace-zebra
 - Cache 缓存 : tair
 - Mq : mafka client

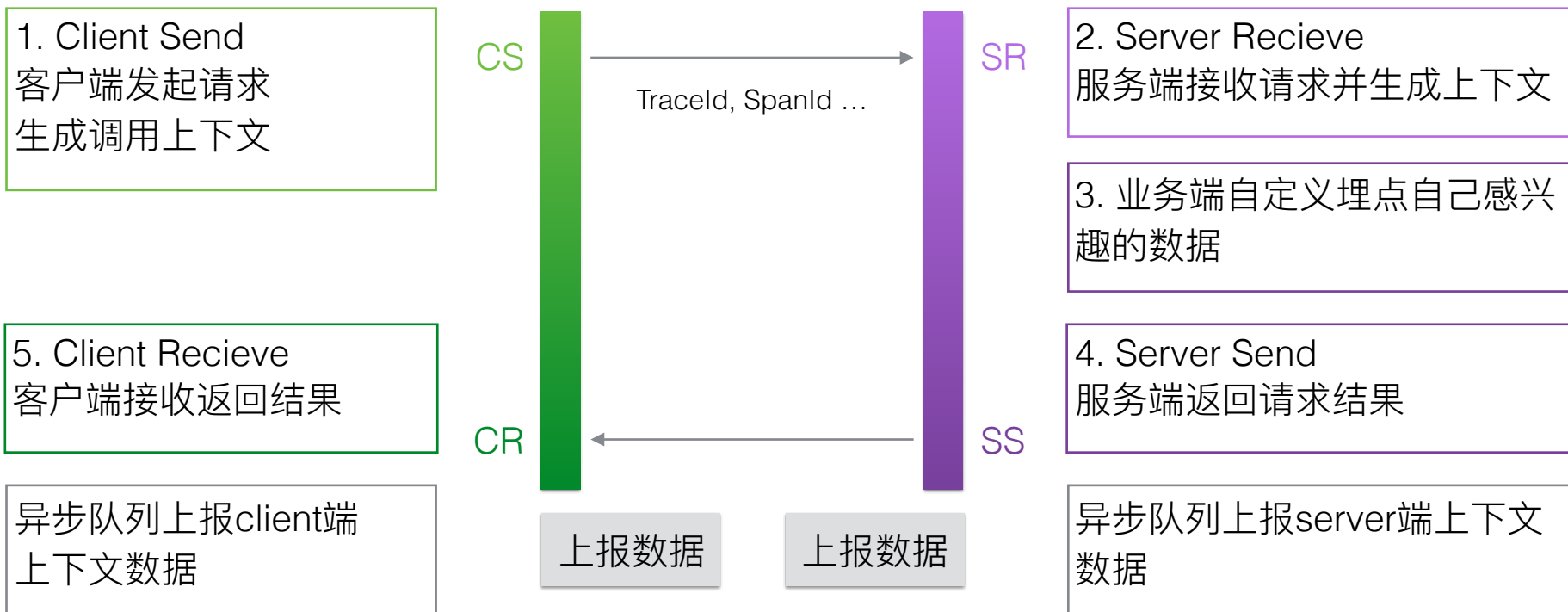


数据埋点

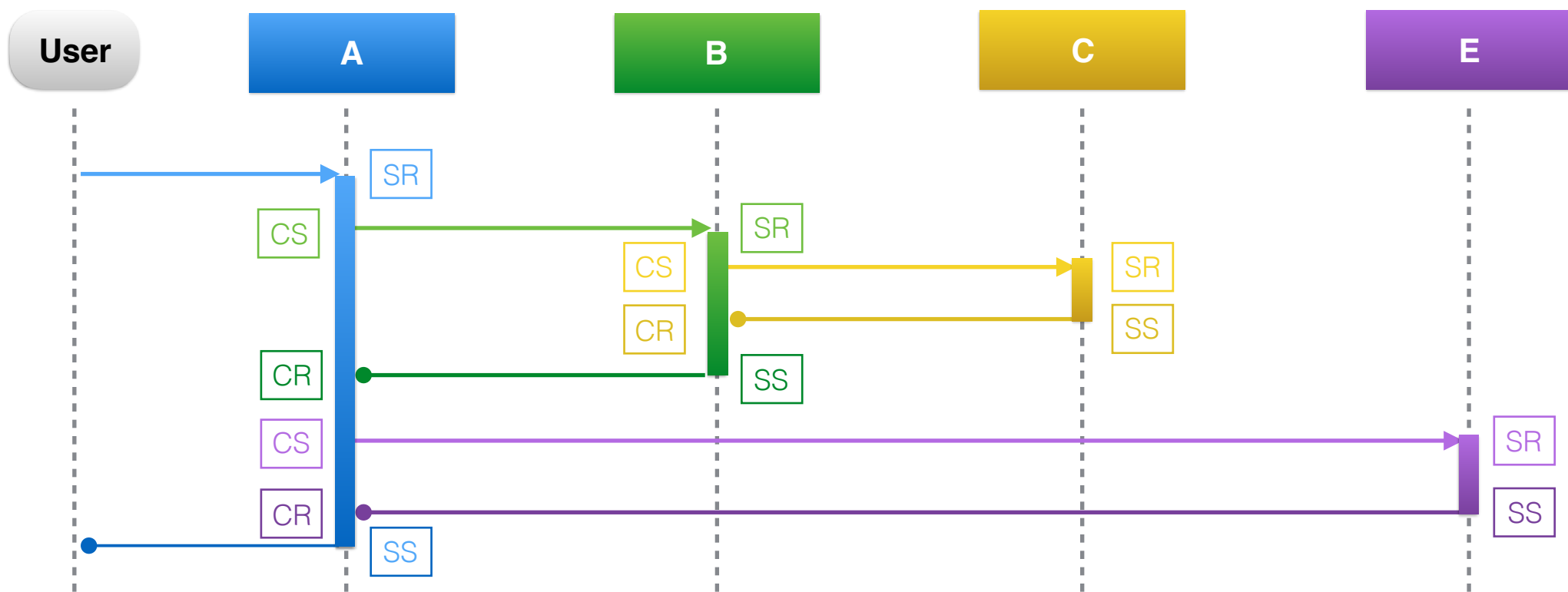
- Traceld
 - 全局唯一标识, 64位整数
- SpanId
 - 签名方式生成: 0, 0.1, 0.1.2, 0.2 ...
- Annotation
 - 业务自定义埋点, uid, 订单id等关键信息
- Other
 - 服务名, 方法名, 耗时, 结果, 中间件类型等



数据埋点-四个阶段

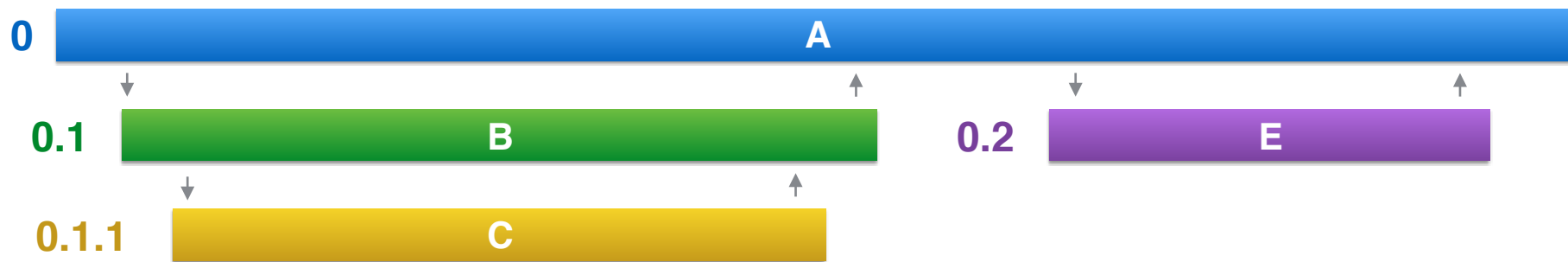


数据埋点-上下文



CS, SR : 创建上下文 CR, SS : 归档上下文

数据埋点-上下文归档



traceld 123456, spanId 0.1.1, appKey C, method C.method, start 106, duration 30, side server
traceld 123456, spanId 0.1.1, appKey B, method C.method, start 105, duration 33, side client
traceld 123456, spanId 0.1, appKey B, method B.method, start 103, duration 38, side server
traceld 123456, spanId 0.1, appKey A, method B.method, start 103, duration 38, side client
traceld 123456, spanId 0.2, appKey E, method E.method, start 148, duration 12, side server
traceld 123456, spanId 0.2, appKey A, method E.method, start 146, duration 15, side client
traceld 123456, spanId 0, appKey U, method A.method, start 100, duration 82, side server

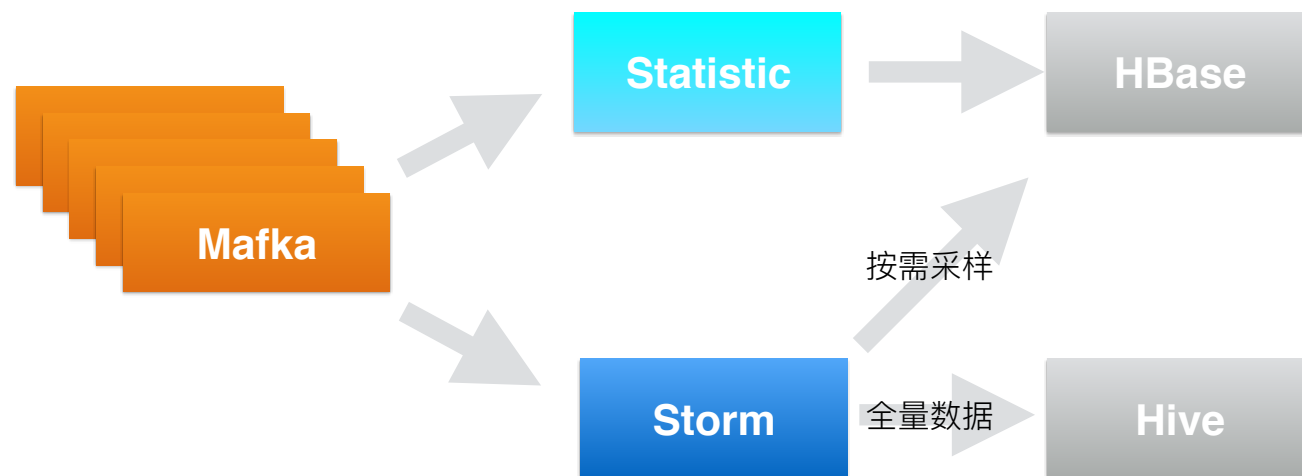
数据埋点一遇到的问题

- 异步调用
 - 异步IO造成的线程切换，不能通过ThreadLocal传递上下文
 - 显式的通过api进行埋点传递，切换前保存，切换后还原
- 数据量大，每天千亿级别的调用
 - 批量上报
 - 数据压缩
 - 极端情况下采样



数据存储

- 实时数据HBase
 - 用于实时调用链路查询
 - 性能统计数据
- 离线数据Hive
 - 离线分析
 - 定制化查询汇总



调用链实时数据存储

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- 实时数据Hbase，用于实时调用链路查询
- Rowkey traceId 天然随机
- 列名 SpanId - Type, 埋点上下文

	T									
RowKey	0-C	0.1-S	0.1.1-C	0.1.1-S	0.1.2-C	0.1.2-S	0.2-C	0.2-S	0.2.1-C	0.2.1-S
traceId1	Span	Span	Span	Span						
traceId2	Span	Span					Span	Span	Span	Span
traceId3	Span	Span	Span	Span	Span	Span	Span	Span		



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Figure 1 displays performance comparison results for two systems, labeled 'all' and 'com.sankuai.tair.waimai.server'. The figure includes two line charts and a table of API response times.

Left Chart (all): Shows response time (latency) in milliseconds (ms) for 50th, 90th, and 99th percentiles, and GPS. The x-axis represents time from 01:06:15 to 01:06:18 on Wednesday. The y-axis ranges from 0ms to 80ms. The 99th percentile (blue line) shows significant spikes, reaching up to 80ms. The 50th (red) and 90th (green) percentiles remain relatively stable, mostly below 20ms. GPS (orange line) is also stable, around 10ms.

Right Chart (com.sankuai.tair.waimai.server): Shows response time (latency) in milliseconds (ms) for 50th, 90th, and 99th percentiles, and GPS. The x-axis represents time from 01:06:15 to 01:06:18 on Wednesday. The y-axis ranges from 0ms to 80ms. The 99th percentile (blue line) shows significant spikes, reaching up to 80ms. The 50th (red) and 90th (green) percentiles remain relatively stable, mostly below 20ms. GPS (orange line) is also stable, around 10ms.

Table: The table lists various API endpoints, their IP addresses, and their response times in milliseconds (ms). The columns are: 告告 (Request), IP, 耗时 (Response Time), 网络耗时 (Network Time), and 耗时 (Response Time). The table is divided into two sections: 'all' and 'com.sankuai.tair.waimai.server'.

告告	IP	耗时	网络耗时	耗时
external_api	N/A	79	N/A	FoodApiV8.getFoodSpuLastByWinPold:79ms
ucenter	10.32.70.86	0	N/A	WinUCThriftService.getUseBaseInfoByToken:0ms
server	N/A	0	N/A	GetRequest:0ms
chase	10.32.163.163	1	N/A	ChaseTagThriftService.getCaseCodeByWinPold:1ms
sourcecenter	10.4.200.233	10	N/A	WinCApiAppContainerThriftService.getSourceId:10ms
chase	10.32.96.164	1	N/A	CPThriftService.getPostBaseById:1ms
productquery	10.32.75.231	2	5	WinProductQueryThriftService.getWinProductTagByWinPold:2ms
productquery	10.32.106.208	2	5	WinProductQueryThriftService.getWinProductSpuCountyTagId:2ms
productquery	10.32.161.152	4	N/A	WinProductQueryThriftService.getWinPold:4ms
productquery	10.32.172.210	2	N/A	WinProductQueryThriftService.getWinStockSkusByWinPold:2ms
activity	10.32.140.6	5	N/A	WinActivityItemThriftService.getWinActivityItemCollections:5ms
server	N/A	1	N/A	SearchGetRequest:1ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	1	N/A	GetRequest:1ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	1	N/A	GetRequest:1ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	1	N/A	GetRequest:1ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	1	N/A	GetRequest:1ms
server	N/A	0	N/A	GetRequest:0ms
server	N/A	0	N/A	GetRequest:0ms

谢谢大家

